

VERTICAL MIGRATION OF THE EDIBLE CRAB, *CANCER PAGURUS* (CRUSTACEA: DECAPODA: BRACHYURA), ON ROCKY SHORES OF THE SOUTH COAST OF NORWAY

Crustacean foraging activity in the intertidal zone during high tides, and sheltering in subtidal areas during low tides, has been noted on numerous occasions by many authors. Besides the study by Robles *et al.* (1989) on diel variation of intertidal foraging by *Cancer productus* L. in British Columbia, Canada, there exist only a few quantitative studies of temporal variations of such habits (Robles *et al.*, 1989).

It has been known for many years that *Cancer pagurus* L. (the only commercial crab in Norway) makes diurnal vertical movements on rocky shores of the Norwegian Skagerrak coast during the summer and early autumn (Nordgaard, 1912; Bjerkan, 1927; Dannevig and Gundersen, 1982). According to Dannevig and Gundersen, many crabs move to shore level at night to forage, and angling for crabs with flash light and scoop net on summer nights has a long tradition. This kind of cyclical movement of *C. pagurus* has not been reported from other parts of the crab's range, from the Mediterranean to northern Norway (Christiansen, 1969), nor has a close study of this activity been previously undertaken. Here we describe skin-diving surveys of cyclical movements of *C. pagurus* during the night, and throughout the year, on rocky shores on the Norwegian Skagerrak coast.

Study Area and Results

The study area was a small unsheltered rocky islet between Grimstad and Lillesand c.150 m from the mainland (58°16'19"N, 8°32'33"E). The islet is c. 290 m in perimeter, and a maximum of 100 m across. The whole field area covered c. 3700 m², bounded in depth by the upper limit of *Laminaria digitata* (Hudson) (3–5 m), and the water line. The common mussel, *Mytilus edulis* L., occupied a broad zone in the study area. The survey reported here was carried out between March and December 1980. Temperature, salinity, water level, height of waves, directions of current and wind, and light conditions were recorded during all surveys. The difference in tide at the study area is 17 cm.

No crabs were seen on the first night-survey (30 March), nor were any individuals observed at night on the two next surveys (1 and 3 May). On 24 May, and until the last survey on 11 December, crabs were observed on all 30 nights of survey. On all surveys, crabs were observed eating *M. edulis*, and random examinations showed that the crab stomachs usually were filled with fragments of the mussel. A maximum of 237 crabs were counted during a survey on 22 June. In contrast only 1 crab was observed during the night survey on 7 August. This low number may be due to the moulting and mating processes which occur at this time of the year.

In late August surveys were carried out every fourth hour throughout 24 hours. Only 2–3 crabs were observed during day time, whereas the highest number, 91 crabs, was counted between two and three hours after sunset. Surveys were also carried out during the daytime on 9 different days, but only 0 to 4 crabs were observed on these surveys.

Carapace width throughout the investigation period varied between 50–190 mm for females and 50–200 mm for males, with the highest number between 130–150 mm and 120–140 mm, respectively. Females were regarded as sexually mature at 130 mm, but females with eggs were never observed in the study area. According to the literature (Edwards, 1979; Dannevig and Gundersen, 1982) crabs with a carapace width of 115 mm should be about 5 years old, and older individuals may be up to 300 mm in carapace width.

Tagging of crabs was done while swimming in the field area. Of 542 tagged crabs, 136 (25%) were recaptured from 1 to 7 times at the islet or within a 0.5 km radius, during the study period. In addition, 44 crabs (8.1%) were found between 0.5 and 28 km from the islet. Two of these had earlier been recaptured at the islet. The last recapture of a long-distance migrant crab was two years after tagging. The percentage of recaptured individuals at the islet was highest for males, whereas a higher percentage of females was recaptured more than 0.5 km from the islet. That females of *C. pagurus* make extensive migrations has previously been mentioned by several authors (Edwards, 1979).

Literature Cited

- Bjerkan, P. 1927. Undersøkelser over krabben (*Cancer pagurus*). Aarsberetning vedkommende Norges Fiskerier for 1926: 141–162.
- Christiansen, M.E. 1969. 'Crustacea Decapoda Brachyura. Marine invertebrates of Scandinavia 2'. (Universitetsforlaget: Oslo). 143p.
- Dannevig, G. and Gundersen, K.R. 1982. Taskekrabben. 230–234. In R. Frislid and A. Semb-Johansson (eds) 'Norges dyr, Vol. 4: Virvellose dyr'. (J.W. Cappelens Forlag A/S: Oslo).
- Edwards, E. 1979. 'The edible crab and its fishery in British waters'. (Fishing News Books Ltd: Farnham, Surrey, England). 142p.
- Nordgaard, O. 1912. Faunistiske og biologiske iakttagelser ved den biologiske station i Bergen. Det Kongelige norske Videnskabers Selskabs Skrifter 1911 (6): 1–58.
- Robles, C., Sweetnam, D.A. and Dittman, D. 1989. Diel variation of intertidal foraging by *Cancer productus* L. in British Columbia. Journal of Natural History 23: 1041–1049.

Kjell Karlsson and Marit E. Christiansen, Zoological Museum, University of Oslo, N-0562 Oslo 5, Norway.